

REMARKS

Claims 1-7, 9-11, 13, 15-22 and 24-35 were examined and reported in the Office Action. Claims 1-7, 9-11, 13, 15-22 and 24-35 are rejected. Claims 1, 11, 20 and 29 are amended. Claims 1-7, 9-11, 13, 15-22 and 24-35 remain.

Applicant requests reconsideration of the application in view of the following remarks.

I. Claim Objections

It is asserted in the Office Action that Claims 1, 11, 20 and 29 are objected as being unclear. Specifically, it is asserted in the Office Action that the limitations of "an explicit-multiple thread" is not understood. Applicant has amended the aforementioned claims to include the limitation of "application" after the limitations "an explicit-multiple thread." An ordinary skilled person in the art of multi-thread processing environments should understand that multi-threaded environments execute explicit multi-threaded applications or must convert a single thread application into a multi-threaded application when using multi-thread resources in order for the application to be processed. Applicant's claimed invention makes it unnecessary to convert single thread applications to explicit multi-threaded applications.

Accordingly, withdrawal of the objections for Claims 1, 11, 20 and 29 are respectfully requested.

II. 35 U.S.C. §103

A. It is asserted in the Office Action that claims 1-7, 9-10 and 29-35 are rejected under 35 U.S.C. §103(a) as being unpatentable over by Sundaramoorthy et al. ("Slipstream Processors: Improving both Performance and Fault Tolerance", ASPLOS, pp. 257-268, Nov. 2000) ("Sundaramoorthy") in view of Hennessy and Patterson ("Computer Architecture A Quantitative Approach", Morgan Kaufmann, 1996)

("Hennessy"). Applicant respectfully traverses the aforementioned rejections for the following reasons.

According to MPEP §2142

[t]o establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. (In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)).

Further, according to MPEP §2143.03, "[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. (In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974)." *"All words in a claim must be considered in judging the patentability of that claim against the prior art."* (In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970), emphasis added.)

Applicant's amended claim 1 contains the limitations of

[a]n apparatus comprising: a first processor and a second processor each having a scoreboard and a decoder; a plurality of memory devices coupled to the first processor and the second processor; a first buffer coupled to the first processor and the second processor, the first buffer being a register buffer; a second buffer coupled to the first processor and the second processor, the second buffer being a trace buffer; and a plurality of memory instruction buffers coupled to the first processor and the second processor; wherein the first processor and the second processor perform single threaded applications using multithreading resources, and the first processor executes a single threaded application ahead of the second processor executing said single threaded application to avoid misprediction, and said single threaded application is not converted to an explicit

multiple-thread application, said single threaded application contains the same number of instructions when executed on said first processor and said second processor, and said single threaded application executed on the second processor avoids branch mispredictions using information received from said first processor.

Applicant's amended claim 11 contains the limitations of

[a] method comprising: executing a plurality of instructions in a single thread by a first processor; executing said plurality of instructions in the single thread by a second processor as directed by the first processor, the second processor executing said plurality of instructions ahead of the first processor to avoid misprediction; tracking at least one register that is one of loaded from a register file buffer, and written by said second processor, said tracking executed by said second processor, transmitting control flow information from the second processor to the first processor, the first processor avoiding branch prediction by receiving the control flow information; transmitting results from the second processor to the first processor, the first processor avoiding executing a portion of instructions by committing the results of the portion of instructions into a register file from a first buffer, the first buffer being a trace buffer, and clearing a store validity bit and setting a mispredicted bit in a load entry in the first buffer if a replayed store instruction has a matching store identification (ID) portion in a second buffer, the second buffer being a load buffer, wherein the first processor and the second processor execute single threaded applications using multithreading resources, and said single thread is not converted to an explicit multiple-thread application, said single threaded application contains the same number of instructions when executed on said first processor and said second processor, and said single threaded application executed on the second processor avoids branch mispredictions using information received from said first processor.

Applicant's amended claim 20 contains the limitations of

[a]n apparatus comprising a machine-readable medium containing instructions which, when executed by a machine, cause the machine to perform operations comprising: executing a single thread from a first processor; executing

said single thread from a second processor as directed by the first processor, the second processor executing instructions ahead of the first processor to avoid misprediction; tracking at least one register that is one of loaded from a first buffer, and written by said second processor, said tracking executed by said second processor, the first buffer being a register file buffer, and clearing a store validity bit and setting a mispredicted bit in a load entry in a second buffer if a replayed store instruction has a matching store identification (ID) portion, the second buffer being a trace buffer, wherein the first processor and the second processor execute single threaded applications using multithreading resources, and said single thread is not converted to an explicit multiple-thread application, said single threaded application contains the same number of instructions when executed on said first processor and said second processor, and said single threaded application executed on the second processor avoids branch mispredictions using information received from said first processor.

Applicant's amended claim 29 contains the limitations of

[a] system comprising: a first processor and a second processor each having a scoreboard and a decoder; a bus coupled to the first processor and the second processor; a main memory coupled to the bus; a plurality of local memory devices coupled to the first processor and the second processor; a first buffer coupled to the first processor and the second processor, the first buffer being a register buffer; a second buffer coupled to the first processor and the second processor, the second buffer being a trace buffer; and a plurality of memory instruction buffers coupled to the first processor and the second processor, wherein the first processor and the second processor perform single threaded applications using multithreading resources, the first processor executes a single threaded application ahead of the second processor executing said single threaded application to avoid misprediction, and said single thread is not converted to an explicit multiple-thread application, said single threaded application contains the same number of instructions when executed on said first processor and said second processor, and said single threaded application executed on the second processor avoids branch mispredictions using information received from said first processor.

Sundaramoorthy discloses a multiprocessor system that executes two (i.e., multiple streams/threads) pseudo-redundant programs on separate processors on the same chip. The two redundant programs have a different amount of instructions. (Sundaramoorthy, column 2, lines 34-56). That is, one of the programs has more instructions than the other. (Sundaramoorthy, page 258, first column, lines 40-55). Sundaramoorthy further discloses that the A-stream has fewer instructions than the R-stream, which receives information from the A-stream. Both programs run in parallel on two processors. Sundaramoorthy, however, does not teach, disclose or suggest “the first processor executes a single threaded application ahead of the second processor executing said single threaded application to avoid misprediction, and said single threaded application is not converted to an explicit multiple-thread application, said single threaded application contains the same number of instructions when executed on said first processor and said second processor, and said single threaded application executed on the second processor avoids branch mispredictions using information received from said first processor.” In other words, Sundaramoorthy executes multiple-streams on two separate processors where each stream has a different number of instructions, as opposed to Applicant’s claimed invention, which executes a single thread application without converting or duplicating the single thread application to a multiple-thread application when using multiple-thread processing resources, where the single thread application is executed on two processors without changing the number of instructions (i.e., an exact duplicate).

Hennessey discloses using scoreboarding to aid in allowing instructions to execute out of order. Sundaramoorthy, however, is directed to finding instructions that do not effect final program output and removes these instructions from a second stream, for example redundant instructions. Therefore, the combination of the two prior art documents would not result in Applicant’s claimed invention. Further, Hennessey does not teach, disclose or suggest “the first processor executes a single threaded application ahead of the second processor executing said single threaded application to avoid misprediction, and said single thread is not converted to an explicit multiple-thread application, said single threaded application contains the same number

of instructions when executed on said first processor and said second processor, and said single threaded application executed on the second processor avoids branch mispredictions using information received from said first processor.”

Neither Sundaramoorthy, Hennessy, nor the combination of the two, teach, disclose or suggest the limitations contained in Applicant's amended claims 1, 11, 20 and 29, as listed above. Since neither Sundaramoorthy, Hennessy, nor the combination of the two teach, disclose or suggest all the limitations of Applicant's amended claims 1, 11, 20 and 29, claims 1, 11, 20 and 29 are not obvious over Sundaramoorthy in view of Hennessy since a *prima facie* case of obviousness has not been met under MPEP §2142. Additionally, the claims that directly or indirectly depend from amended claims 1, 11, 20 and 29, namely claims 2-7 and 9-10, 12-13, 21-27, and 30-35, respectively, would also not be obvious over Sundaramoorthy in view of Hennessy for the same reason.

Accordingly, withdrawal of the 35 U.S.C. § 103(a) rejections for Claims 1-7, 9-10 and 29-35 are respectfully requested.

B. It is asserted in the Office Action that claims 11, 13, and 15-19 are rejected under 35 U.S.C. §103(a) as being unpatentable over Sundaramoorthy in view of Hennessy and in further view of Akkary (WO 99/31594). Applicant respectfully traverses the aforementioned rejection for the following reasons.

Applicant's claims 13 and 15-19 directly depend on amended claim 11. As asserted above in section II(A), neither Sundaramoorthy, Hennessy, nor the combination of the two teach, disclose or suggest the limitations contained in Applicant's amended claim 11.

Akkary discloses a system for ordering loads and stores in a multi-threaded processor using load and store buffers. Applicant is well aware of Akkary as Akkary is owned by Applicant's Assignee. Akkary does not teach, disclose or suggest “the first processor and the second processor execute single threaded applications using multithreading resources, and said single thread is not converted to an explicit multiple-thread application, said single threaded application contains the same number

of instructions when executed on said first processor and said second processor, and said single threaded application executed on the second processor avoids branch mispredictions using information received from said first processor.”

Therefore, combining Akkary with Sundaramoorthy and Hennessy would still not result in Applicant’s amended claim 11 as the combination would still produce multiple-threads from a single thread, process on separate processors, where the two threads contain a different number of instructions.

Neither Sundaramoorthy, Hennessy, Akkary, nor the combination of the three, teach, disclose or suggest the limitations contained in Applicant's amended claim 11, as listed above. Since neither Sundaramoorthy, Hennessy, Akkary, nor the combination of the three, teach, disclose or suggest all the limitations of Applicant's amended claim 11, Applicant's amended claims 11 and 20 are not obvious over Sundaramoorthy in view of Hennessy, and further in view of Akkary since a *prima facie* case of obviousness has not been met under MPEP §2142. Additionally, the claims that directly depend from amended claim 11, namely claims 13 and 15-19, would also not be obvious over Sundaramoorthy in view of Hennessy and further in view of Akkary for the same reason.

Accordingly, withdrawal of the 35 U.S.C. § 103(a) rejections for Claims 11, 13, and 15-19 are respectfully requested.

C. It is asserted in the Office Action that claims 20-22, and 24-28 are rejected under 35 U.S.C. §103(a) as being unpatentable over Sundaramoorthy in view of Hennessy in view of Akkary, as applied above, and in further view of “Structured Computer Organization,” Prentice-Hall, 1984, pp. 10-12 (“Tanenbaum”). Applicant respectfully traverses the aforementioned rejections for the following reasons.

Applicant has addressed amended claim 20 regarding Sundaramoorthy in view of Hennessy above in section II(A). Akkary has been addressed above in section II(B) regarding claim 11, which contains similar limitations, albeit being a method claim.

Tanenbaum is relied on for asserting that “any instruction executed by hardware can also be executed in software.” Tanenbaum, however, does not teach, disclose or suggest “the first processor and the second processor execute single threaded applications using multithreading resources, and said single thread is not converted to an explicit multiple-thread application, said single threaded application contains the same number of instructions when executed on said first processor and said second processor, and said single threaded application executed on the second processor avoids branch mispredictions using information received from said first processor.”

Therefore, combining Tanenbaum with Sundaramoorthy, Hennessy and Akkary would still not result in Applicant’s amended claims as the combination would still produce multiple-threads from a single thread and process on separate processors where the two threads have the same number of instructions.

Neither Sundaramoorthy, Hennessy, Akkary, Tanenbaum, nor the combination of the four, teach, disclose or suggest the limitations contained in Applicant's amended claim 20, as listed above. Since neither Sundaramoorthy, Hennessy, Akkary, Tanenbaum, nor the combination of the four, teach, disclose or suggest all the limitations of Applicant's amended claim 20, Applicant's amended claim 20 is not obvious over Sundaramoorthy in view of Hennessy and Akkary and further in view of Tanenbaum since a *prima facie* case of obviousness has not been met under MPEP §2142. Additionally, the claims that directly or indirectly depend from amended claim 20, namely claims 21-22 and 24-28, would also not be obvious over Sundaramoorthy in view of Hennessy and Akkary, and further in view of Tanenbaum for the same reason.

Accordingly, withdrawal of the 35 U.S.C. § 103(a) rejections for Claims 20-22, and 24-28 is respectfully requested.

CONCLUSION

In view of the foregoing, it is believed that all claims now pending, namely 1-7, 9-11, 13, 15-22 and 24-35, patentably define the subject invention over the prior art of record and are in condition for allowance and such action is earnestly solicited at the earliest possible date.

If necessary, the Commissioner is hereby authorized in this, concurrent and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2666 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17, particularly extension of time fees.

Respectfully submitted,

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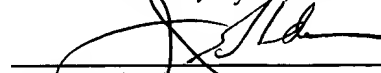


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